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No. 2

A HANDBOOK OF
COMMON GARDEN PESTS

Designed for the Thousands of Pennsylvania
Amateur Gardeners Aiding Our Gov-
ernment in the Great War

By J. G. SANDERS, Economic Zoologist
Bureau of Economic Zoology, Circular No. 6



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FOREWORD.

Verily, the troubles of the amateur gardener are many,
Having strained his muscles and ligaments almost to the point of collapse,
And creaking in every joint for days following his unusual efforts to break and pulverize the soil,
He sows seeds and sets out his plants with almost injurious care,
Only to find in an unguarded moment his neighbor's chickens, dogs or cats enjoying the odor and softness of the newly turned soil;
And perhaps the hungry cutworm and grub proffer their nightly attention to the promising new plants,
And so a succession of vermin, bugs, "worms" and blights seems to pursue every activity of the inexperienced gardener in heartless and determined onslaught throughout the summer.
To this class of troubled patriots of 1918,—or more,—this handbook is dedicated.

NOT OUR BIT BUT OUR BEST.

EXPLANATORY.

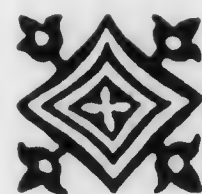
This handbook, limited in size, outlines very briefly a few of the more important insect and disease pests injurious in gardens.

Fuller accounts are available in bulletins and circulars of State and Government agricultural departments and experiment stations. They can be secured for the asking.

Popular language, to the best of the writer's ability, is employed to discuss the following subjects in order:—

- (1) Insects and plant diseases defined and contrasted.
- (2) Common garden insects.
- (3) Common garden plant diseases.
- (4) Formulae for spraying materials. Repellants and fumigants.
- (5) Spraying apparatus and machinery.
- (6) Garden sanitation and autumn care.

It is the belief of the writer that the employment of a little timely effort in the application of controls suggested herein will be many times repaid through increased production. As "Mony mickles mak' a muckle," so even a slight saving of crops from pests in each garden, when multiplied by many thousands will add a tremendous total to our food supply.



WHAT IS AN INSECT? WHAT IS A PLANT DISEASE?

Hazy ideas and curious notions exist in the minds of many people regarding insects and plant diseases:—their origin, multiplication, dissemination, effect on plants and controls being sources of curious conjecture. This is not a surprising state of affairs when we consider the decided lack of instruction in our schools on these important subjects. A loss of two billion (\$2,000,000,000) dollars each year to our agricultural crops, as estimated by government authorities, is too serious to be passed over lightly by our thinking American citizens.

INSECTS are invertebrate (without backbone) animals of low order, having a body composed of three main parts (head, thorax and an abdomen of seven to ten segments), with or without wings, and never more than six legs. (Spiders, mites and ticks are not true insects.) Insects generally lay eggs (a few give birth to living young) which hatch and pass through several transformations or stages to the adult.

Most important to the grower is a knowledge of how an insect pest secures its food, whether by **chewing** and swallowing bits of plant food, or by piercing and **sucking** out the plant juices, or lapping up liquids.

Chewing insects are controlled by sprays of arsenic compounds, but **sucking** insects must be hit with a contact spray of corrosive or oily nature for killing effect. Special uses of poisons and formulae are discussed later.

Plant diseases are caused by bacteria, slime-moulds or fungi, which attack the tissues and interfere with the growth and reproduction of plants. Sometimes moisture or soil conditions produce harmful results which simulate genuine diseases.

Bacteria, slime-moulds and fungi are low forms of plant life which attack plant or animal tissues, either living or dead. Plant diseases are distributed by wind, water and animals, or other agencies which may involve direct contact of diseased with healthy plants or infected objects. Many bacteria and fungous spores are so small that 5,000 to 10,000 might be placed in line side by side to reach an inch. Therefore, one can understand how easily diseases may be carried from place to place on seeds, tubers, bulbs, plants, or by other means.

Insects play a very important part in carrying and distributing plant diseases, and as our studies continue, their serious role is disclosed.

Controls of plant diseases are largely preventive, and mainly consist (1) of treatment or disinfection of seeds, tubers, etc., before planting, or (2) coating susceptible plant foilage with chemical compounds destructive to spores which may find lodgment thereon, and (3) soil sanitation and crop rotation.

COMMON INSECT PESTS.

CUTWORMS.

Young plants, cut off at the surface of the ground and lying nearby, are sure evidences of night attacks of cutworms. These smooth, dull brown or mottled larvae hide nearby in the soil, or under debris in daylight, and feed at night, finally growing to one

and one-half inches in length. They later pupate and emerge as night-flying owlet moths with dull or mottled forewings, and lighter hindwings; and are strongly attracted to lights. There are many different species of this family,

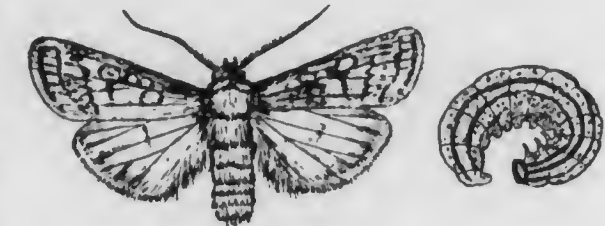


Fig. 1.

Noctuidae, in Pennsylvania, but their habits are similar.

Control:—Fall plowing and cultivation of the soil is helpful. An application in spring of poison bran mash (see formula No. 4), over prepared ground before planting is a sure preventive of loss. A heavy paper collar fitted loosely around reset plants, extending an inch into the soil and three or four inches above, will generally protect them from the cutworms.

STALK BORERS.

Smooth, spotted and striped worms related to the cutworms, bore into the stems of tomatoes, potatoes, dahlias and other plants. After boring lengthwise in the stem, they bore out, and may attack nearby plants in similar manner, causing much damage by wilting of plants

above the point of injury. These borers attain a length



Fig. 2.

of one to one and a quarter inches.

Coarse weeds are the usual host plants for stalk-borers, while any young succulent weed leaves furnish food for the very young borers until strong enough to bore into heavy stalks.

Control:—The only reasonable control measures consist in keeping down all weeds about gardens, and cutting out and destroying any larvae at work.

WHITE GRUBS AND WIREWORMS.

Thick, fleshy white grubs, usually curled in a half circle, destroy the roots of many kinds of plants underground, and often damage potato tubers. These grubs, the larvae of common May beetles or

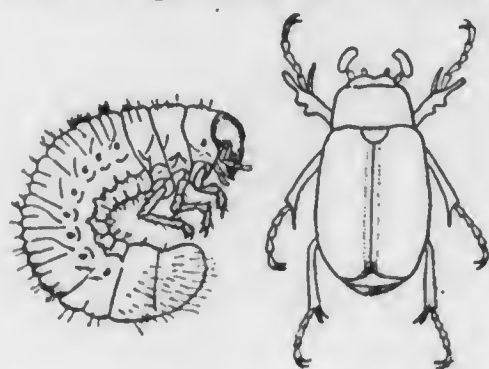


Fig. 3.

“June bugs,” never feed above ground as cutworms do, therefore cannot be poisoned by any known method. The grubs remain in the soil two or three years before changing to a May beetle.

Control:—Early fall plowing or spading, and thorough harrowing will kill many grubs. In small gardens dig out and destroy grubs when evidence of attack is discovered. Strawberry plants quickly show injury.

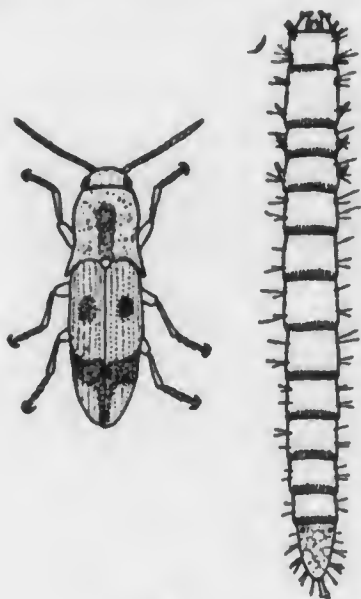
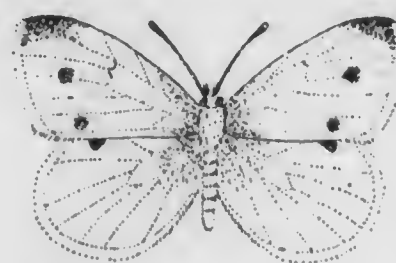


Fig 4.

Wireworms are slender, shiny brown, hard-shelled larvae of small “snap” or click beetles. They attack roots of plants, and are more abundant in low, wet ground. These and white grubs naturally feed on roots of grasses, —hence sod land used for garden is likely to be infested. Control of both groups is similar.

CABBAGE WORMS.

Three species of green “worms” commonly attack cabbage leaves and heads:—(a) The common white butterfly always seen flying about cabbage plants,



lay the eggs which hatch and produce the dull dark green “worms” so destructive to the leaves and heads. (b) The “looper” is pale green, larger, more wrinkled, with a looping habit, and usually less abundant. (c) The diamond back moth larva is very small, less than one-half inch, and works

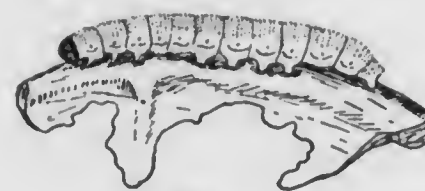


Fig. 5.

deep into the new, unfolding head.

Control:—Foolish notions of danger in applying poisons to cabbage deter many from protective measures. Since a cabbage head grows from within, and outside leaves are removed, there is no possible chance of poison remaining in the head. Only when a well-developed head is cracked open could any poison be introduced. Powdered arsenate of lead (Formula No. 1), or paris green mixed with three parts of slacked lime or plaster paris should be blown on the plants occasionally. Ordinary water sprays run off too quickly to be effective.

POTATO BEETLES.

Two important beetles, widely different in size and appearance, attack potato foliage:—(a) The common

10-striped Colorado potato beetle and its deep red larvae devour the foliage rapidly, and unless checked quickly, strip the stalks bare. (b) The tiny black jumping flea beetles cause more damage than many realize, for they cut tiny holes in the leaves, and also carry and distribute the blight. In some years flea beetles cause more damage than the Colorado beetle by attacking the leaves, and the larvae attack the tubers.



Fig. 6.

Control:—As soon as plants appear above ground watch for the beetles and their larvae. Apply at occasional intervals Bordeaux mixture and arsenate of lead (No. 12), or Bordeaux and paris green.

CUCUMBER BEETLES.

It is most discouraging to find some morning a wilted cucumber vine, just when it seemed to be growing well, and a foot or two long. No apparent injury is seen, yet close examination of the stem just at the ground's surface will show tiny white, thread-like larvae of the striped cucumber beetle at work, causing a spongy condition. The adult beetles attack the young foliage.

Control:—Keep young plants well dusted with arsenate of lead and slaked lime. A handful of powdered tobacco placed about the stem kills larvae.

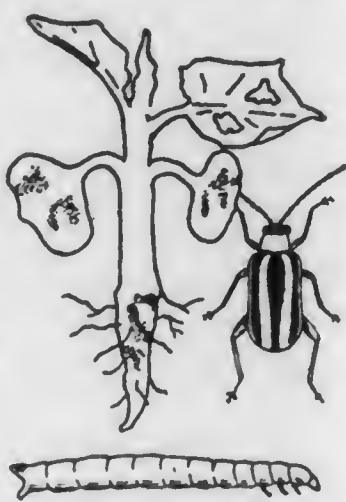


Fig. 7.

ASPARAGUS BEETLE.

Dark blue and white checkered beetles and their slate-gray larvae devour the asparagus tips and delicate foliage. The slender eggs are placed on end along the leaflets.

Control:—Arsenate of lead spray occasionally.



Fig. 8.

SQUASH BUG.

Young squash and pumpkin plants are injured by the squash bug, a rather large brown bug with a jointed sucking beak and an offensive odor. Many shiny brown eggs, looking like tiny seeds, are laid in orderly arrangement on the underside of foliage.

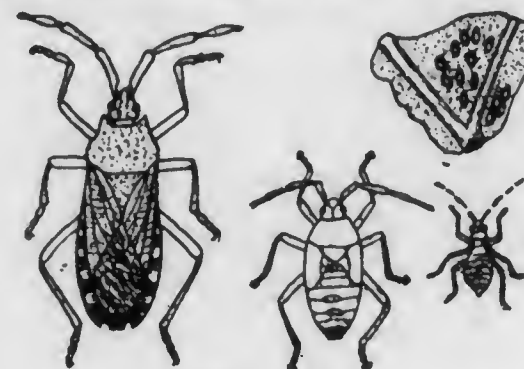


Fig. 9.

Control:—Examine leaves and destroy eggs and young by crushing them. Spray strong enough to kill the bugs may injure the young plants.

RADISH AND CABBAGE MAGGOTS.

Small white maggots burrow and tunnel through the flesh of radishes (Fig. 10), and eat away the underground stem of young cabbage, cauliflower and onion plants. The adult is a dark colored fly, about the size of the common housefly, which lays eggs at the base of the young plants in the soil. There may be two or three generations each year.

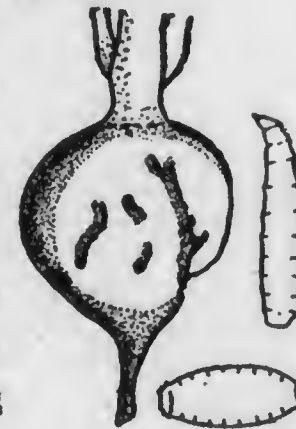


Fig. 10.

Control:—For small gardens powdered lime or tobacco dust sifted closely about the very young plants is helpful as a control. Disks of heavy tarred felt slit to the center, and fitted about cabbage and cauliflower plants, and pressed down closely on top the soil will save most of the young plants. For treatment of large areas of cabbage, cauliflower and onions, a poisoned bait spray to kill the adults is used. Particulars on application.

APHIS OR PLANT LICE.

Thousands of tiny green, brown or black lice which multiply rapidly are often found sucking the juices from many kinds of plants. There are many species, and some attack entirely different plants in succeeding generations. As soon as these lice are observed on plants, apply treatment at once, before they multiply to astonishing numbers.

Control:—Nicotine preparations or tobacco decoctions diluted with soap and water are safe and successful sprays (see Nos. 5, 6, 8). Every insect must be hit with the spray in order to kill.

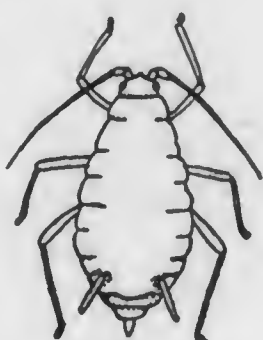


Fig. 11.

CORN EAR WORM.

Sweet corn and field corn ears are ruined by dull striped "worms", that devour and foul the grains when soft. This pest is related to the cutworms, and develops from eggs laid on the corn silks by brownish moths.

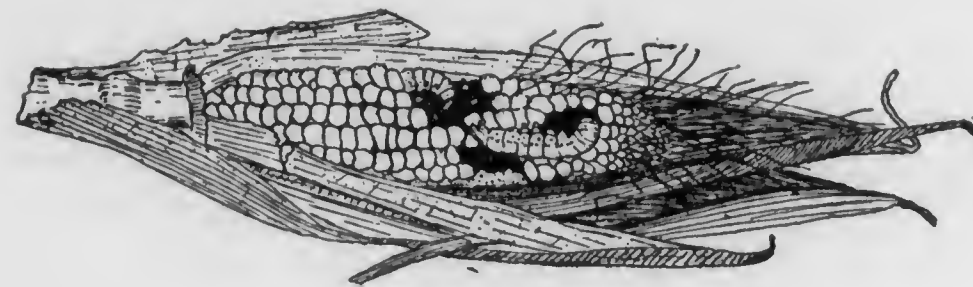


Fig. 12.

Control:—Powdered arsenate of lead mixed half and half with slaked lime or plaster paris, and blown on the silks when fully showing, will kill the young larvae at first feeding.

TOMATO WORM.

These large well known and destructive pests can be readily poisoned when young with lead arsenate. Hand picking of older larvae is best in small gardens.

BEAN AND PEA WEEVILS.

Stored beans and peas are usually attacked by weevils, which feed as grubs within the seeds, and leave large exit holes on emergence. Several generations may occur in a year, completely ruining the seed.



Fig. 13.

Control:—As soon as beans or peas are dried and ready for storage, place them in a tight box or can, and fumigate for two or three days with carbon disulfide (see No. 10). Good success demands fumigation at temperature above 70 degrees Fahr. Keep away lights, because carbon disulfide gas is explosive.

RED SPIDER.

Tiny red or two spotted mites making a slight web on leaves of many tender plants, cause a

blanched or rusty appearance of the foliage, especially in dry seasons. These creatures are not insects, but are closely related. Ordinary insecticides do not control them.

Control:—Thorough and frequent dusting of affected plants with finely powdered sulfur, or frequent hard syringing with water under pressure, will hold them in check.

COMMON PLANT DISEASES.

BEAN ANTHRACNOSE.

This disease is generally observed as purplish or brownish sunken spots on bean pods, although it also attacks leaves and stems. The disease is carried with the seed and only seed from healthy pods should be saved and used.

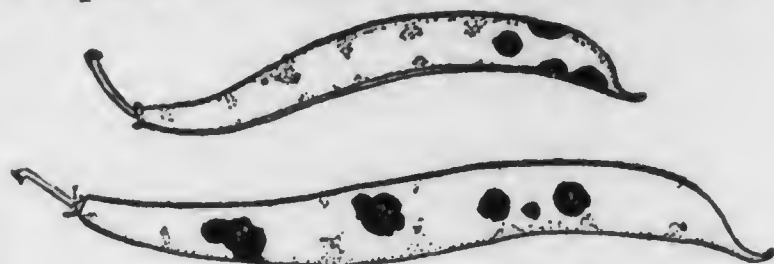


Fig. 14.

Control:—Early and persistent Bordeaux spraying will check the trouble (see No. 11). Never cultivate beans while foliage is damp.

BEET LEAF SPOT.

Brownish sunken or dead spots on beet leaves with reddish-purple margins are caused by this fungus disease. Warm rains and heavy dews in warm weather favor its rapid development, and finally the leaves may wither and dry up.

Control:—Early spraying with Bordeaux mixture.

CABBAGE DISEASES.

Black Rot is a destructive and almost uncontrollable bacterial disease, causing gradual yellowing of leaves from the margin toward the middle veins, which turn black. Affected leaves fall off prematurely, and often the stalk and head become dwarfed on one side. Turnips, cauliflower and related mustard plants are susceptible.

Control:—The soil becomes infected and crop rotation is the only control possible. Pull and burn diseased plants.

Club Root is caused by a slime-mould which stunts and generally kills young plants. Older plants becoming infected produce striking malformations and irregular swellings of the roots, like stubby fingers. It also attacks radishes, rutabaga, cauliflower, brussels sprouts and other mustards.

Control:—None but crop rotation and careful observation of the seed bed is advisable. Heavy applications of lime (40-50 lbs. per square rod), worked into soil several months preceding planting.

Yellows is another uncontrollable disease readily transmitted by infected soil, and the disease may remain virile in the soil for several years, even in the absence of cabbage crops. Disinfect seed with corrosive sublimate 1-1000 for ten minutes.

Black-leg causes plants to turn purple. The leaves wilt but usually remain on the stem. Tiny black dots occur in diseased sunken spots on stem and leaves.

Control:—Disinfect seed and plant in new clean soil.

LETTUCE WILT OR DROP.

Two or three distinct diseases may cause this common trouble which is frequently called "damping off." These diseases also attack other plants in similar fashions, especially in seed beds.

Control:—Soil sanitation and aeration are best. Soil sterilization in seed beds by steam has proved successful. Powdered sulfur mixed with wood ashes has been reported as beneficial.

ONION SMUT.

This troublesome disease has been satisfactorily controlled by wetting the soil about the onion seed as it is planted with formalin solution, 1 pint to 30 gallons of water, using a tank with rubber tube attachment to the furrow, all mounted on the seeder.

POTATO DISEASES.

Scab is the well known, conspicuous, rough pitted disease on the tubers, caused by a fungus which is the source of great damage and loss wherever potatoes are grown. A little care at slight cost will overcome the trouble.

Control:—If possible rotate crops to clean soil. Most important is a soaking of the tubers before cutting (see Nos. 14, 15). Then be careful that they are not reinfected by bags or boxes which have held untreated potatoes.



Fig. 15.

Early Blight is distinctly a leaf spot disease which produces circular or ovate brown spots with concentric lines, and can be readily distinguished from tip burn.

Control:—Bordeaux mixture applied when plants are young.



Fig. 16.

Late Blight and Rot attack foliage causing indefinite brown or black areas, and if uncontrolled run down, causing large blackened irregular spots in the flesh of the tubers.



Fig. 17a.



Fig. 17b.

Control:—Use no seed potatoes showing dark diseased spots or rings, and spray with Bordeaux mixture (No. 11), especially in August and September.

TOMATO BLIGHT AND LEAF SPOT.

The same fungus which causes late blight of potatoes causes rapid blighting of tomato foliage and quick rotting of the fruit. Leaf-spot is a distinct disease producing brown spots which multiply rapidly and the leaves shrivel and die.

Control:—Spray occasionally with Bordeaux mixture (No. 11). Remove and burn affected fruit.

REMEDIES FOR INSECTS AND PLANT DISEASES.

Formulae for Preparation and Use.

Remember Always—Bordeaux mixture controls most fungus diseases, but will not kill insects.

Arsenate of lead kills **chewing** insects and may be added to Bordeaux for double purpose spray.

Nicotine solution kills soft bodied **sucking** insects. Arsenate of lead and paris green are useless for these pests.

CONTROLS FOR CHEWING INSECTS.

L. (a)		Quantity	Small Amt.
{	Arsenate of lead (powder)	1½ to 2 lbs.	2 heaping tablespoonfuls
	Water	50 gallons	1 gallon
(b) {	Arsenate of lead (paste)	3 to 4 lbs.	as above
	Water	50 gallons	

Better than paris green—costs less, sticks better, will not burn foliage, and is ready for use at once. Apply thoroughly without fear of foliage injury.

K. Paris green (powder)	-	½ pound	1 tablespoonful
Fresh lime	-	2 pounds	1 ounce
Water	-	50 gallons	1 gallon

Slake the lime in small quantity of water, strain and add to mixture, to prevent burning. Paris green kills quickly, especially when used for potato beetles, but washes off readily in rainy weather.

3. White Hellebore may be dusted on plants bearing nearly ripened fruit without danger of poisoning. It is often used for currant worms.

4. Poison bran mash for cutworms and grasshoppers:

Common bran (or shorts)	20 lbs.	1 quart
Paris green	½ lb.	teaspoonful
Molasses	1 qt.	tablespoonful

Mix bran and poison dry, add syrup and water to make a dry mash when thoroughly stirred. Broadcast late in evening. Orange and lemon juice adds to its attractiveness.

CONTROLS FOR SUCKING INSECTS.

5. Nicotine solution (commercial), diluted according to directions with water and soap, is used for aphids and other soft bodied sucking insects. "Black Leaf 40" diluted 1 to 1,000 parts of water is sufficiently strong for aphids. This and other preparations may be purchased at seed stores and drug stores.

6. Tobacco decoction may be made at home by steeping (not boiling) one pound of tobacco stems or leaves in three gallons of water for an hour or more, in a covered vessel. Strain, add soap and spray. Does not injure tender plants.

7. Kerosene emulsion is used for aphids, etc., but is less safe and more troublesome to make than nicotine sprays.

Kerosene	-	2 gallons
Hard soap (Ivory)	-	½ lb.
Water (soft or rain)	-	1 gallon

Dissolve the soap in the water, remove from fire. Add the kerosene, and agitate violently until a creamy white emulsion is formed, which thickens like gelatin when cold. For spraying dilute with eight to ten parts of water, and stir thoroughly.

8. Powdered tobacco will destroy root aphids, and certain other pests like earthworms and slugs, if a handful is piled at the base of plants, where water leaches out the poison, and carries it downward. Beneficial for potted plants.

REPELLENTS.

9. Powdered slaked lime and powdered tobacco are good repellents, driving away many insects, but not necessarily killing them. Sifted lime and plaster of paris are good "carriers" for dry lead arsenate or paris green. Any material with an odor of tobacco, kerosene, tar, carbolic acid, camphor or naphthaline acts as a repellent for insects, but rarely kills them.

FUMIGANTS.

10. Carbon disulfide is a clear, ill-smelling liquid which evaporates rapidly. The vapor is much heavier than air, and is explosive. It is, an excellent and safe fumigant for weevil-infested seeds. Use a tablespoonful to each cubic foot of space in a tight can or box, and fumigate for a day or two. Keep away lights.

Warning.—Many proprietary mixtures are on the market for controlling insects and plant diseases, but none are better than the common materials recommended in this circular, except that one pays more for the same material, or for a lot of useless filler.

CONTROLS FOR PLANT DISEASES.

11. Bordeaux mixture (pronounced bor-do) is the standard spray for control of fungus diseases of truck crops, mildew on roses, grapes, etc. It is also used in fruit tree spraying extensively; but under certain conditions, has been replaced by lime-sulfur solution.

	Quantity	Small Amt
Copper sulfate (blue-stone)	4 lbs.	3 gallons
Quicklime	4 lbs.	$\frac{1}{2}$ lb.
Water	50 gallons	3 gallons

In a wooden, earthenware or glass vessel dissolve the bluestone with warm water. Never use metal containers. Slake the lime in sufficient water by adding a little at a time until a milk of lime is produced. Add more water and strain. Pour in the bluestone solution while stirring it, and apply immediately. This solution deteriorates within a few hours if allowed to stand.

Stock Solutions of bluestone and milk of lime can be prepared and kept indefinitely in closed jars, to be mixed when needed for spraying.

Caution:—Always rinse out and thoroughly cleanse all spray machinery and nozzles when through spraying with Bordeaux mixture, or any solutions containing lime.

12. Combination insecticide and fungicide. Arsenate of lead or paris green can be added to Bordeaux mixture as a combination double purpose spray for the control of chewing insects and plant diseases. Add the lead arsenate and paris green to the lime water before adding the bluestone solution.

13. Powdered sulfur blown on rose bushes and other plants is helpful in controlling certain mildews, and also kills red spiders, as noted elsewhere.

K. Formalin (formaldehyde 40%)	-	1 lb.	or 1 oz.
Water	-	30 gals.	1 gal.

Soak seed potatoes before cutting in this solution for two hours, to kill scab. Keep treated potatoes from reinfection by old sacks or boxes used for potatoes.

K. Corrosive sublimate	-	4 oz.	or 1 oz.
Water	-	30 gals.	7 gals.

Dissolve the sublimate (very poisonous) in a little hot water, then add remainder, and soak the seed potatoes for an hour and a half before cutting. Allow them to dry before planting. This is more effective than formalin disinfection.

Caution:—Corrosive sublimate is very poisonous and corrosive. Never use metal pails or dishes for this material, and thoroughly cleanse everything.

SMALL SPRAY APPARATUS.

No gardener should be without some kind of a sprayer to fit his needs. It is a wise investment. Buy a good, portable, efficient outfit, and proper care will insure years of service. Brass containers, pumps and nozzles will resist the action of corrosive liquids like Bordeaux, while tin or galvanized parts are soon ruined.



Fig. 18.

The small hand atomizer (Fig. 18), with glass or brass container is satisfactory for a very small garden and flowers, but a compressed air sprayer (Fig.

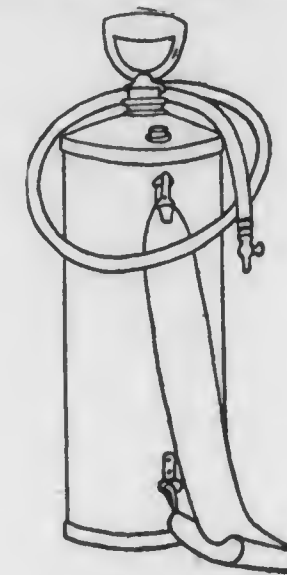


Fig. 19.

19), is a better investment, considering labor and length of service. A bucket spray-pump (Fig. 20), is likewise serviceable, and can be used for spraying, whitewashing and washing windows where water pressure is lacking.

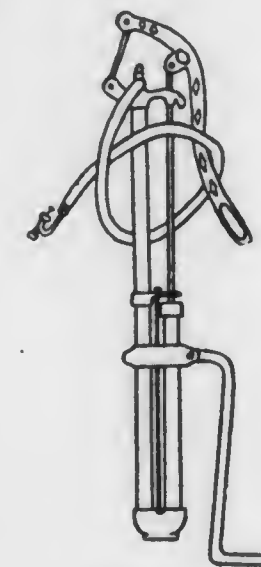


Fig. 20.

Various types of small hand dusters are now available, and are strongly advised for quick application

of powders while plants are damp with dew. Several neighbors might club together to purchase a good outfit for larger and more general use. Most seed stores and hardware dealers carry small outfits.

There is a vast difference between **spraying** and **sprinkling**. The latter wastes liquid and never covers the plant uniformly. A fine misty spray evenly coats the foliage, and no spot is left untreated. 'Nuff said.

GARDEN SANITATION.

Crop remnants and weeds left in a garden in the autumn promote the multiplication of innumerable pests for the following season. Weeds mature their seeds to sprout next spring in prodigious numbers, while insects and diseases have an opportunity to survive the winter in good condition. Destroy all crop remnants and weeds in the fall by turning them under, thereby conserving humus and fertility while starving the insects, and eliminating plant diseases, except as noted previously. Many common garden pests live on weeds related botanically to our garden crops. Clean cultivation and destruction of adjacent weeds should be a constant practice.

END OF YEAR